TYPE 2000

BAR & DOT GENERATOR

INSTRUCTION BOOK

Tel-Instrument
ELECTRONICS CORP.

728 GARDEN STREET
CARLSTADT, NEW JERSEY 07072

TYPE 2000 BAR AND DOT GENERATOR

INSTALLATION

The Type 2000 requires 2 input signals -- a horizontal drive signal (15,750 cps.) of at least 3 volt amplitude, and a blanking signal (15,750 and 60 cps.) of at least 3 volt amplitude. The horizontal drive should be connected to one of the coax jacks marked "HDI." The companion jack should be either terminated or used to feed the signal to a terminated line. The blanking signal should be connected to one of the jacks marked "BI", and the other terminated or used to feed the signal to a terminated line. The switch on top of the chassis should be on the "+" position if a positive blanking signal is being fed into the unit, and in the "-" position for a negative blanking signal. Now disconnect the blanking signal from the camera or monoscope which is to have the linearity signal connected to it, and instead connect to the camera or monoscope unit a signal from either the "PCBO" or "NCBO" jacks, depending upon whether a positive or negative blanking signal is required. (Do not terminate this cable when using the Telequip monoscope unit.)

Turn on the rest of the equipment and turn on the Type 2000 by pushing the button marked "STD". If a normal picture cannot be obtained by varying R-61, it may be necessary to readjust the blanking control on the camera or monoscope, or R-61 as described under Maintenance. Now push the "BAR" push button, and a pattern of horizontal and vertical bars should appear on the monitor screen. If the vertical bars are not stationary on the screen, adjust R-14 on the Type 2000 chassis. If now the horizontal lines are not stationary, and about 13 or 14 in number, readjust R-21 and R-25 slightly.

The panel control marked "HOR PHASE" will move the pattern sideways to clear the horizontal resolution wedges of the monoscope pattern, and the "HOR WIDTH" control will vary the horizontal width of the vertical lines -- do not attempt to use very thick lines. The positions of this control at which the keying pulse is an integral number of lines wide will give the least flicker. If the proper adjustment cannot be made as described above, see the maintenance section of this instruction book.

The "HOR" and "VERT" push buttons will give, respectively, only horizontal or only vertical lines. The "DOT" button will give a pattern of dots corresponding to the intersections of the horizontal and vertical lines. The "STD" button will give a normal blanking signal without any linearity markers. To turn the unit off, press the "POWER" push button.

THEORY OF OPERATION

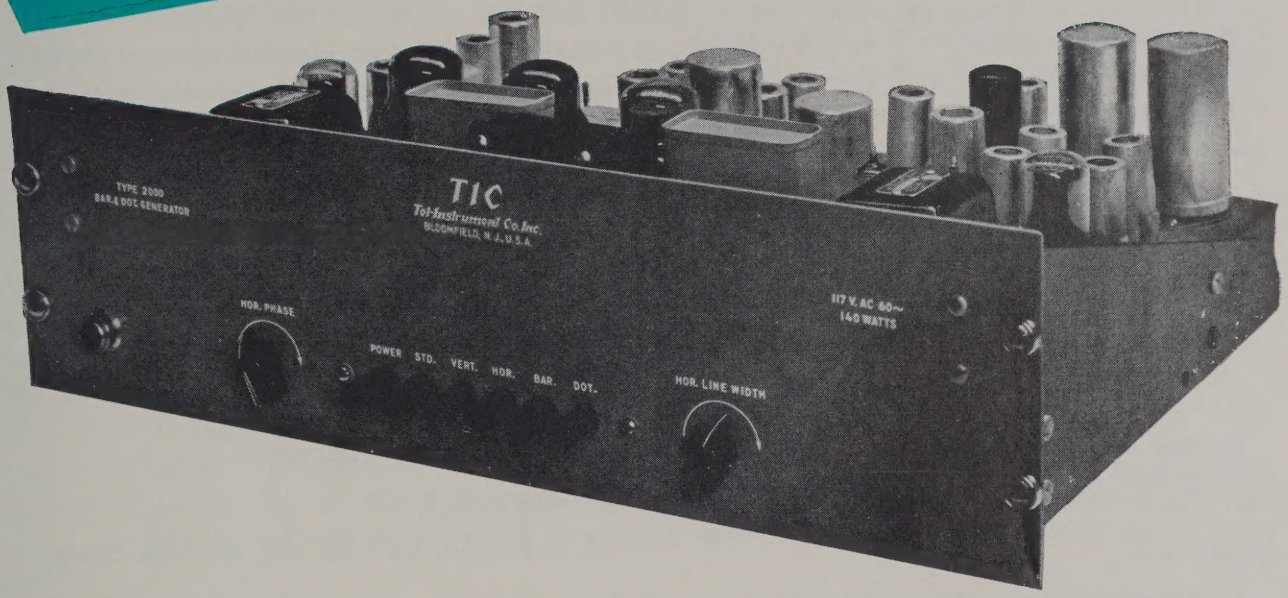
The main operating signal for the Type 2000 Bar and Dot Generator is a horizontal driving signal, having a repetition rate of 15,750 pulses per second and an amplitude of at least 3 volts. In order to obtain a pulse for the following circuits which is independent of variations in the input signal, the 15,750 pps. input signal is fed to tube V-5, a 1:1 blocking tube oscillator (BTO). This stage is synchronized to the input signal by adjusting R-14. The sawtooth voltage appearing across R-13 is fed to the grid of V-6, which is operated as a doubler stage, with its plate circuit tuned to 31,500 cps. Coils L-7 and L-8, together with mutual coupling capacitance C-44, form a double tuned transformer, so that the output signal of this stage is a very pure 31,500 cps. sine wave. This purity of wave-form is essential for proper interlacing of the horizontal bars. A 100 micro-micro-farad variable capacitor across L-8 serves as an adjustable phase shifter. Although the phase shift obtainable at this frequency is only about $\pm 25^{\circ}$, after the multiplication by ten described below, a phase shift of about 500° at 315KC is obtained, so that the vertical bars may be positioned anywhere on the screen.

The 31,500 cps. sine wave is fed to the grid of V-1 and multiplied in frequency 5 times, to 157,500 cps. The coil in the plate circuit of this tube is coupled by mutual inductance to L-2, which feeds the grid of V-2, another doubler. The output of this stage, at 315,000 cps., is fed, through a mutual inductance-coupled transformer, to V-3, which acts as a straight tuned amplifier. The output of this stage is fed to V-4, which acts as a shaping tube.

TIC *Product Information*

TYPE 2000 BAR & DOT GENERATOR

Tel-Instrument ELECTRONICS CORP., 728 Garden St., Carlstadt, N. J.



USES:

The Type 2000 Bar and Dot Generator, when used in conjunction with any standard Synchronizing Signal Generator, provides the signals needed for properly adjusting the horizontal and vertical sweep linearity of television receivers. The Type 2000 Generator is also an excellent instrument for the precise adjustment of the deflection linearity of television station pick-up cameras. It is also ideal for the adjustment of the sweep linearity of studio control desk picture monitors and client room program viewing units.

DESCRIPTION:

The Type 2000 Bar and Dot Generator consists of frequency multiplying and dividing circuits that will generate 315,000 and 900 pulses per second together with suitable mixing circuits to combine these pulses with the usual blanking signal so as to create 15 horizontal and 20 vertical lines (less those lost due to the blanking intervals) when viewed on a television receiver or studio picture monitor. A push button switch on the front panel permits selection of any of the following modes of operation:

A. Standard blanking (no signal added)

B. Vertical bars only

C. Horizontal bars only

D. Vertical and horizontal bars

E. Dot pattern.

The Type 2000 receives a horizontal driving pulse and a blanking signal from the associated sync signal generator, and delivers both positive and negative modified blanking signals. The normal blanking signal is disconnected from the monoscope or camera which is to receive the linearity signal, and the modified blanking signal from the Type 2000 connected instead.

A phasing control is located on the front panel to permit shifting the vertical bars along the "X" axis so as to avoid superimposing the bar on the resolution wedge of the monoscope test pattern.

The power supply is self contained and is electronically regulated so as to assute freedom from line voltage fluctuations between 105 and 125 volts.

TYPE 2000 BAR AND DOT GENERATOR

INSTALLATION

The Type 2000 requires 2 input signals -- a horizontal drive signal (15,750 cps.) of at least 3 volt amplitude, and a blanking signal (15,750 and 60 cps.) of at least 3 volt amplitude. The horizontal drive should be connected to one of the coax jacks marked "HDI." The companion jack should be either terminated or used to feed the signal to a terminated line. The blanking signal should be connected to one of the jacks marked "BI", and the other terminated or used to feed the signal to a terminated line. The switch on top of the chassis should be on the "+" position if a positive blanking signal is being fed into the unit, and in the "-" position for a negative blanking signal. Now disconnect the blanking signal from the camera or monoscope which is to have the linearity signal connected to it, and instead connect to the camera or monoscope unit a signal from either the "PCBO" or "NCBO" jacks, depending upon whether a positive or negative blanking signal is required. (Do not terminate this cable when using the Telequip monoscope unit.)

Turn on the rest of the equipment and turn on the Type 2000 by pushing the button marked "STD". If a normal picture cannot be obtained by varying R-61, it may be necessary to readjust the blanking control on the camera or monoscope, or R-61 as described under Maintenance. Now push the "BAR" push button, and a pattern of horizontal and vertical bars should appear on the monitor screen. If the vertical bars are not stationary on the screen, adjust R-14 on the Type 2000 chassis. If now the horizontal lines are not stationary, and about 13 or 14 in number, readjust R-21 and R-25 slightly.

The panel control marked "HOR PHASE" will move the pattern sideways to clear the horizontal resolution wedges of the monoscope pattern, and the "HOR WIDTH" control will vary the horizontal width of the vertical lines -- do not attempt to use very thick lines. The positions of this control at which the keying pulse is an integral number of lines wide will give the least flicker. If the proper adjustment cannot be made as described above, see the maintenance section of this instruction book.

/

The "HOR" and "VERT" push buttons will give, respectively, only horizontal or only vertical lines. The "DOT" button will give a pattern of dots corresponding to the intersections of the horizontal and vertical lines. The "STD" button will give a normal blanking signal without any linearity markers. To turn the unit off, press the "POWER" push button.

THEORY OF OPERATION

The main operating signal for the Type 2000 Bar and Dot Generator is a horizontal driving signal, having a repetition rate of 15,750 pulses per second and an amplitude of at least 3 volts. In order to obtain a pulse for the following circuits which is independent of variations in the input signal, the 15,750 pps. input signal is fed to tube V-5, a 1:1 blocking tube oscillator (BTO). This stage is synchronized to the input signal by adjusting R-14. The sawtooth voltage appearing across R-13 is fed to the grid of V-6, which is operated as a doubler stage, with its plate circuit tuned to 31,500 cps. Coils L-7 and L-8, together with mutual coupling capacitance C-44, form a double tuned transformer, so that the output signal of this stage is a very pure 31,500 cps. sine wave. This purity of wave-form is essential for proper interlacing of the horizontal bars. A 100 micro-micro-farad variable capacitor across L-8 serves as an adjustable phase shifter. Although the phase shift obtainable at this frequency is only about $\pm 25^{\circ}$, after the multiplication by ten described below, a phase shift of about 500° at 315KC is obtained, so that the vertical bars may be positioned anywhere on the screen.

The 31,500 cps. sine wave is fed to the grid of V-1 and multiplied in frequency 5 times, to 157,500 cps. The coil in the plate circuit of this tube is coupled by mutual inductance to L-2, which feeds the grid of V-2, another doubler. The output of this stage, at 315,000 cps., is fed, through a mutual inductance-coupled transformer, to V-3, which acts as a straight tuned amplifier. The output of this stage is fed to V-4, which acts as a shaping tube.

The "POS" and "NEG" push bar [illegible] will give [illegible] positive, only horizontal or only vertical lines. The "NOR" button will give a pattern of dots corresponding to the intersection of the horizontal and vertical lines. The "TOP" button will give a normal blinking [illegible] without any lineamity [illegible]. To turn the [illegible] off, press the "POWER" [illegible] button.

FACILITY OF OPERATION

[illegible]

[illegible]

[illegible]

The 31,500 cps. signal from V-6 is also fed to two BTO divider stages, consisting of V-7 and V-8, which divide in the ratios of 5:1 and 7:1, so that the output of V-8 is a positive pulse at a repetition rate of 900 cps. This pulse is used to trip one-shot multivibrator V-9, producing a positive pulse adjustable in width from about 60 microseconds to several hundred microseconds. The first half of V-10 is diode connected to act as a DC restorer, so that the output voltage is zero for a short period of time, and highly negative the rest of the time.

We now have available as our basic signals to be mixed, a 900 pps. positive pulse and a 315,000 pps. positive pulse, both in the neighborhood of 10% wide. By properly combining these pulses, we obtain the desired output signals as follows:

For standard blanking only, both signals are grounded, and V-10b and V-11 are biased to cutoff, so no output signal is obtained from these tubes.

For vertical bars only, the cutoff bias is removed from the mixers, and the 315,000 pps. signal is fed to grid 3 of V-11, while the 900 pps signal is grounded. This results in an output signal from V-11 which consists of continuous 315,000 pps. negative pulses.

For composite bars, the cutoff bias is removed from the mixers, the 315,000 pps. signal is fed to grid 3 of V-11, and the 900 pps. signal to the grid of V-10b. Plate current flows during the positive portion of either signal, since the plates of the two tubes are connected in parallel, and hence the output signal is composed of continuous trains of both 315,000 pps. and 900 pps. negative pulses.

For dots, the cutoff bias is removed from the mixers, the 315,000 pps. signal is fed to grid 3 of V-11, and the 900 pps. signal is fed to grid 1 of V-11. Under these conditions, plate current flows only when both signals are positive, as the amplitudes are sufficient to cut the tube off during the negative excursions of the pulses. The output signal therefore consists of short bursts of 315,000 pps. negative pulses, the bursts having a repetion rate of 900 pps.

The negative pulses obtained in any of the steps just outlined are fed into grid 3 of V-12, while an amplified negative blanking signal from V-15 is applied to grid 1. V-15 is arranged for other inverting or non-inverting operation by switch S-2, as required by the polarity of input blanking. The amplitude of this latter signal is such that V-12 is cutoff during the negative portion of this signal, which corresponds to normal blanking time. Thus, during the normal picture time, the signals described before appear in the plate circuit of V-12, but not during the blanking time, when only a positive blanking pulse appears.

The output of V-12 is clipped in V-13, and applied to a double output stage employing V-14, a high-gm power pentode. A positive blanking signal is obtained from the plate circuit of this tube, and a negative blanking signal from the cathode circuit. It will be noted that the linearity marker pulses have the same polarity as the blank-out direction of the blanking pulse, and therefore the linearity markers appear as narrow black bars or dots.

[illegible] negat[illegible] to [illegible]. [illegible] in any of the steps just outlined [illegible] into grid [illegible] of V-12, while an amplified negative [illegible] signal from V-15 [illegible] applied to grid [illegible]. V-1[illegible] [illegible] either inverting or non-inverting operation [illegible] by [illegible] V-4, as required by the polarity of [illegible] blanking. The amplitude of this last [illegible] signal is such that V-14 is cut off during the negative portion of this signal, which corresponds to normal [illegible] time. Thus, during the normal picture time, the [illegible] is defleated before [illegible] in the plate circuit of V-14, [illegible] during the blank[illegible] time, when only a positive blanking pulse appears.

The output of V-12 is clipped in V-13, and applied to [illegible] stage employing V-14, a high-gm power [illegible]. A positive blanking signal is obtained from the plate circuit of this tube, and a negative blanking signal from the cathode circuit. It will be noted that the [illegible] marker pulses have the same polarity as the blanking pulse, and therefore the blanking pulses appear as narrow black bars or [illegible].

MAINTENANCE

In order to prevent failure of the unit during working hours, it is suggested that the tubes in this unit be checked on a regular schedule, preferably at the same times that the tubes in the associated sync signal generator are checked. The parts used in the Type 2000 are of the highest quality and are run at quite conservative ratings, so that very little trouble should be encountered. Before any service work is attempted the "THEORY" section of this instruction book should be read, so that a clear idea of the function of each circuit will be had. Test points are provided on the rear of the chassis to aid in realigning any of the circuits if the occasion should arise.

In order to properly align this equipment, three pieces of equipment are required -- a properly operating sync signal generator, a DC VTVM such as the RCA Voltohmyst, and an oscillograph having good high frequency response to 5 Mc. Connect the ground lead of the VTVM to the chassis of the Type 2000, and insert the DCV probe into test point #2 on the rear of the chassis. If a reading of 215 volts is not obtained, rotate R-69 until the proper voltage is obtained. If this is not possible within the range of the control, check to see if V-18 is defective. Any other troubles in the regulated power supply should be quite easy to trace, as very few parts are involved.

Connect the Horizontal Driving Pulse from the sync generator to the proper input jack on the 2000, and also connect this signal to the "Ext. Sync Input" post of the oscillograph. Adjust the oscillograph sweep so that two horizontal driving pulses are seen on the screen. Now connect the scope input to test point #8, and adjust R-14 until two pulses are seen on the screen (Note that these pulses are quite sharp, and one of them may be hidden during the retrace time of the scope.). R-14 should be set halfway between the two positions at which the BTO goes out of sync.

Plug the DCV probe of the VTVM into test point #7, set the Hor Phase control on the front panel so that the knob points up (The capacitor C-43 is at half capacity in this position.), and adjust the slugs in L-7 and L-8 for maximum negative voltage (usually between -20 and -50 volts). It should not be necessary to turn either adjusting screws more than two turns. Now pulg the VTVM into test point #5,

and adjust L-1 and L-2 for maximum negative voltage (usually between -30 and -50 volts). Plug the VTVM into test point #3, and adjust L-3 and L-4 for maximum negative voltage (usually between -60 and -80 volts). If the slugs must be turned more than two turns, an oscillograph must be used to check the multiplication factor.

Still using the horizontal driving pulse for synchronizing the oscillograph, set the sweep to view 5 pulses from test point #8. Connect the oscillograph input to test point #6, and adjust R-21 until two pulses are visible on the screen, indicating a division of 5:1 from 31.5 KC. This may be checked by temporarily connecting a 10,000 ohm carbon resistor between test points #6 and #8, which will add a small amount of 15.75 KC pulse to the 6.3 KC pulses from test point #6. Between the first and third 6.3 KC pulse on the screen, there should be 5 small 15.75 KC pulses. Note that one of them may be hidden behind one of the 6.3 KC pulses. Remove the resistor, and use the pulse from test point #6 as a sync pulse for the oscillograph. Adjust the sweep to view 14 pulses from test point #6, and then connect the oscillograph to test point #4. Adjust R-25 until two pulses are visible on the screen, indicating a division of 7:1, from 6.3 KC to 900 cps. This may be checked as before by temporarily connecting a 10,000 ohm resistor between test points #6 and #4, which should put small pulses between each 900 cps. pulse. Note again that one of the 6.3 KC pulses may be hidden behind one of the 900 pps. pulses. In making the adjustments described in this paragraph, be very careful not to neglect pulses which may occur during the blanking time of the oscillograph. Set the "HOR WIDTH" control on the panel to approximately its mid position before going any further.

Connect a Blanking signal from the sync generator to the proper jack on the 2000, set S-2 to the proper positions, and connect a 75 ohm load to the Negative Composite Blanking Output. Depress the BAR push-button, and connect the oscillograph across the 75 ohm load, with the sweep circuit set at 60 and synchronized with the power line. Now rotate R-61 over its range, and note that at one end of the rotation, the 60 pps. blanking pulse disappears. Rotate R-61 from this position until a clean space results during the 60 pps. blanking interval. Do not rotate the control too far, or unwanted "HASH" may creep in. Now reset the oscillograph sweep to 15.75 KC, and synchronize with the signal from test point #8. Rotate the screw of L-6 clockwise until overshoot is noticed on the pulses, then back it off slightly. This completes the adjustments that can be made without using a standard television monitor.

Connect the output of a camera or monoscope chain that is receiving its blanking signal from the 2000 to a standard television monitor, preferably one using at least a 10" tube. Depress the STD push button on the panel and note that a normal picture is obtained on the monitor. Now depress the VERT push button and approximately 17 vertical lines should be observed on the monitor screen. Depress the HOR push button and approximately 13 horizontal lines should be observed on the monitor screen. Rotation of the HOR WIDTH control will vary the thickness of these lines. It will be noticed that certain positions of the HOR WIDTH control give the best appearing lines while other positions appear to have considerable flicker over a portion of the lines. The positions of the control at which no flicker is seen are those at which the 900 pps. pulse from V-9 is an integral multiple of one line wide. Normal position of this control is such that each horizontal line occupies two scanning lines on an interlaced raster. Depression of the BAR and DOT buttons should give, respectively, a horizontal and vertical bar pattern, and a dot pattern representing the intersections of the former bars. Rotation of the HOR PHASE control will move the vertical bars from side to side so that they may be positioned to miss the horizontal resolution wedge of the standard test pattern.

SYM.	TYPE	FUNCTION	Pin	Volts DC	Volts AC	Waveform	Pin	Volts DC	Volts AC	Waveform	Pin	Volts DC	Volts AC	Waveform	Pin	DC
V5	12AX7	BTO	2	-.1	4		1	215	275		3	1.5	4			
		BTO	7	-25	130		6	215	275	Same as V5, Pin 1	8	.1	8			
V6	6AU6	Dblr.	1	-12	30		5	215	375		7	0			6	95
V1	6AU6	X5 Mult.	1	-52	120		5	215	180		7	0			6	100
V2	6AU6	Dblr.	1	-13	22		5	215	150		7	0			6	75
V3	6AU6	Amp.	1	-62	125		5	215	24		7	0			6	100
*V4	6C4	Shaper	6	-1.6	15	Same as V3, Pin 5	1	65	30		7	0				
V7	12AX7	BTO	2	-45	120	Same as V1, Pin 1	1	215	250		3	1.5	10			
		BTO	7	-48	150		6	215	250	Same as V7, Pin 1	8	.1	13			
V8	12AX7	BTO	2	0	12		1	215	480		3	.1	10			
		BTO	7	-43	280		6	215	480	Same as V8, Pin 1	8	.1	20			
V9	12AU7	One-Shot	2	38	20		1	215	70		3	55	35			
		Multi.	7	55	20		6	115	75		8	55	35	Same as V9, Pin 3		
* V10	12AU7	DC Rstr.	2	-68	85		1	-68	85	Same as V10, Pin 2	3	0				
		Mixer	7	-68	85	Same as V10, Pin 2	6	190	75		8	0				
*V11	6BE6	Mixer	1	-25	30	Same as V4, P 1	5	190	20		2	0			6	100
			7	0												
*V12	6BE6	Mixer	1	-3	10		5	160	18		2	0			6	90
			7	-4	20	Same as V11, P 5										
*V13	6AU6	Clipper	1	-95	17	Same as V12, Pin 5	5	210	20		7	0			6	130
*V14	6AG7	Output	4	0	20	Same as V13, Pin 5	8	110	4		5	7	4	Same as V14, Pin 8	6	180
V15	6J6	Blank	6	0	4		1	200	23		7	5	2			
		Amp.	5	0	0		2	200	12							

* Waveforms with switch S1 in Bar Position

ALL RESISTORS ½ W, 10% ALLEN BRADLEY,
UNLESS OTHERWISE SPECIFIED

ALL CAPACITOR VALUES IN MICRO-MICRO FARADS
UNLESS OTHERWISE SPECIFIED

NEXT "R" No. 93
NEXT "C" No. 48

SCHEMATIC
DOT & BAR
GENERATOR

No. 2000 50-1-C

AL SK

Tel Instrument Co Inc